15.—The Stratigraphic Sequence in the Western Portion of the Eucla Basin*

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Drill cores from four bores in the Western Australian portion of the Eucla Basin and two bores in the South Australian portion reveal a sequence of over 1,200 feet of Cretaceous mudstones, sandstones, and greensands overlain by a maximum of 900 feet of Upper Eocene and Lower Miocene limestones. An unexpected thickness of 900 feet of post-Albian greensands and mudstones is present in Madura No. 1 Bore. These are believed to be equivalent in part at least to the greensands of the Gingin District.

Introduction

Through the courtesy of the Government Geologist, Western Australia, cores from Madura No. 1, Madura No. 2, Exploratory Bore No. 3 337-mile peg Transcontinental Railway 28 miles west of Loongana, 245-mile bore Trans-continental Railway, and specimens from Murrawijinnie Cave, Murrawijinnie Bore and Delisser's Bore were made available for palaeontological study. The assistance of the Geological Survey of Western Australia in this matter is gratefully acknowledged.

Stratigraphic Sequence

Basement.—Highly metamorphosed Archaean basement rocks were entered at 1370 feet in 337-mile bore.

Mesozoic shales and sandstones.—The oldest sediments of the Eucla Basin so far determined were entered at the bottom of Madura No. 1 Bore where fossiliferous carbonaceous sandstones of Aptian age occur below 1979 feet, resting on laminated shales, the thickness of which is not proved.

Overlying the Aptian are 1050 feet of paralic sandstones and glauconitic sandstones grading to greensands of possible Albian to Santonian age. The greensands are poorly fossiliferous with fish remains and, rarely, tests of arenaceous foraminifera. In the upper portion of the interval the glauconite is characteristically bright green. These greensands apparently thin out to the north as they are not present in the 337-mile bore.

Correlation with the Molecap Greensand is suggested for part at least of this interval. From the Molecap Greensand plesiosaur bones, fish bones, a belemnite and pelecypoda have been reported (Fairbridge, 1953, p. X/2). In addition, the writer has recovered microscopic fish teeth and a small microfauna of arenaceous foraminifera including *Trochammina* spp., and radiolaria.

Many of the spherical glauconite grains are internal casts or dissolved and redeposited tests of radiolaria whose lattice shell pattern is microscopically discernible on the surface of the glauconite grains.

The Cretaceous glauconitic sands are overlain by Tertiary sands and limestones.

Fig. 1.—Cliffs of Great Australian Bight, south of Koonalda, view east, showing Nullarbor Limestone (dark) over Wilson Bluff Limestone (white).

Tertiary sands and limestones.—The base of the Tertiary is marked by 22 feet of limonitic quartz sand and gravel with polished limonite grains. Above this the Wilson Bluff Limestone of Upper Eocene age attains its maximum thickness of 873 feet in Madura No. 1 Bore. The limestone is a chalky bryozoal calcarenite with flint bands. It is to be correlated with the Torta-

*The present paper was submitted before the paper by M. J. Frost ("Jolnting associated with the Hampton Fault near Madura, W.A." *J. Roy. Soc. W. Aust.* 41: 23-26.) came to hand.

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chilla Limestone of the Adelaide Basin and the limestone of Buccleuch "A" in the Murray Basin. On the Nullarbor Plain it is overlain by the dense crystalline Nullarbor Limestone (Lower Miocene) which appears to have been removed from the Eyre Plain by marine erosion. The microfauna of the Nullarbor Limestone is the same as that of limestone remnants near Kulpara on Yorke Peninsula. These are regarded as of "Batesfordian" age.

Outcropping Limestones of the Hampton Scarp

The writer has not personally visited the area west of Eucla, and knowledge of the outcropping limestones is limited to laboratory examination of rock specimens collected by geologists of Frome-Broken Hill Company Pty. Ltd. in 1954.

Fig. 2.—Cliffs of Great Australian Bight, south of Koonalda, view west. The cliffs are about 300 feet high at this point.

The Hampton Scarp, like the cliffs of the Great Australian Bight (see Figs. 1, 2), is composed of Nullarbor Limestone upon Wilson Bluff Limestone. Two and a half miles north of Eucla the Eyre Highway runs down the scarp to the Eyre Plain (see Fig. 3) over about 30-40 feet of dense, hard Nullarbor Limestone with the chalky bryozoal Wilson Bluff Limestone at the foot. Both are well exposed in a gorge to the west of the Highway.

The Nullarbor Limestone outcrops at the top of Kuthala Pass, 40 miles west of Eucla and forms the cliffs at Madura. Samples taken in the cliffs immediately behind the Madura Motel are of pink-coloured, hard, dense crystalline algal limestone composed largely of the remains of calcareous algae—*Lithothamnium*. The limestone has an attractive appearance when polished (see Fig. 4). In addition to *Lithothamnium*, the Nullarbor Limestone in this area carries a poorly preserved but characteristic microfauna with *Austrotrillina howchini* (Schlumberger) and small miliolidae and rotaliidae. Elsewhere in the Eucla Basin *Marginopora vertebralis* Blainville is generally present in association with abundant miliolidae, and commonly with *Austrotrillina howchini*.

Fig. 3.—Eyre (also Roe) Plain, from Hampton Scarp. 2½ miles north of Eucla.

Specimens collected at the base of the section west of Madura are of partially recrystallized and somewhat friable bryozoal calcarenite differing both lithologically and faunally from the Nullarbor Limestone. The megafauna includes the echinoids *Fibularia gregata* Tate, *"Lovenia forbesi* T. Woods", *Pseudechinus woodsi* (Laube), the mollusca *Chlamys eyrei* (Tate), *Chlamys gambierensis* (T. Woods), and *Eotrigonia semiundulata* (McCoy). Both the megafauna and microfauna are comparable with that of the Mannum Formation of the Murray Basin. It is not certain whether this limestone is a lower member of the Nullarbor Limestone, or, as described by Tate from Wilson Bluff (1879, p. 107), a unit distinct from both the Wilson Bluff and Nullarbor Limestones.

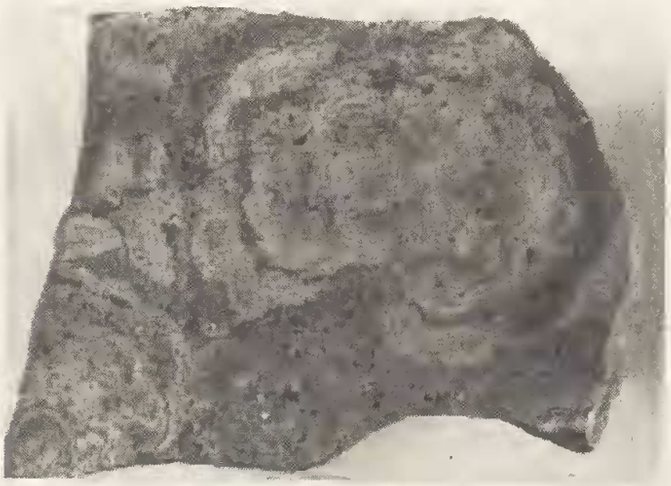

Fig. 4.—Algal limestone (Nullarbor Limestone) Madura.

The Hampton Scarp probably represents the Pleistocene shoreline rather than, as claimed by some writers, a fault scarp. The sedimentary cover of the Eyre Plain (also known as Roe Plain) is of Pleistocene age. Sandy limestones accessible in Madura Cave and penetrated in Madura No. 1 Bore have an abundant molluscan fauna of mostly living species together with several survivors from the South Australian Pliocene. The Nullarbor Limestone has been partially or wholly removed by marine erosion and the Pleistocene appears to rest directly on the Wilson Bluff Limestone.

Examination of the Bores

W.A. Government Survey Exploratory Bore No. 1, Madura

Location: Madura, about 30 chains south from face of Hampton Range escarpment.

110 feet above sea level

Reference 4880. Drilled P.W.D. 1902

0'-8'—Light loam.

8'-30'—Cream shelly limestone, with chalky molluscan shells in a recrystallized matrix, of Pleistocene age.

30'-508'—White bryozoal limestone. Only one sample available over the whole interval the exact depth of which is not stated. The limestone is composed almost entirely of remains of bryozoa. Diagenesis has proceeded too far for ready identification of the foraminifera which include *Textularia* sp. cf. *Stomatorbina torrei* (Cushman & Bermudez), *Gyroidina* sp. The boring entered the Wilson Bluff Limestone (Upper Eocene) in this interval.

508'-766' 9"—Dense chalky limestone with chalcedonic bands, characteristic of the Wilson Bluff Limestone.

766' 9"-903'—Greenish white, partially recrystallized, glauconitic bryozoal limestone, with poorly preserved foraminifera dominated by pelagic species.

Pullenia sp.
Cassidulina sp.
Cibicides sp.
Globigerina mexicana Cushman
Globigerina sp.
Globigerinoides index Finlay
cf. *Heronallenia pusilla* Parr

903'-904' 8"—Brown calcareous grit. This is apparently the basal bed of the Wilson Bluff Limestone. It consists of coarse grains of limonite from the underlying sands and polished coarse subrounded quartz grains in a calcareous matrix.

Moulds of pelecypod fragments are present.

904' 8"-927' 3"—Brown, coarse limonitic quartz sand and gravel, with glossy iridescent grains of limonite and glauconite altering to limonite. The sample is considerably contaminated from the overlying limestone.

The boring is considered to be still in the Eocene at this depth. The name "Hampton Conglomerate" has been applied to the formation (Fairbridge, 1953, p. X1/9), which bears a lithological similarity to the South Maslin Sands of the Adelaide Basin.

927' 3"-928' 6"—Hard band.

928' 6"-963' 6"—Grey-green highly glauconitic silty sand. The sample is carbonaceous and consists of medium to coarse, angular to subrounded, quartz grains with abundant irregular grains of bright green glauconite, and in lesser abundance grey quartz grains, intergrowths of glauconite and hematite, large rounded grains of opaline quartz and pyrite. A single specimen of *Haplophragmoides* sp. cf. *rugosa* Cushman and Waters and one test of an arenaceous foraminifer were recovered from the washings.

963' 6"-968'—Greenish grey, hard, fine-grained, glauconitic sandstone.

968'-988'—Greenish grey, highly carbonaceous, glauconitic silty sandstone. Washings consist of bright green glauconite grains, silt particles, polished, fine to medium, subangular to subrounded, clear quartz grains, a few arenaceous foraminifera including *Haplophragmoides* sp., and fish remains.

988'-1016' 8"—Greenish grey, glauconitic silty grit with bright green glauconite grains, silt particles, coarse subrounded both grey opaline and clear quartz grains with fractured surfaces, muscovite, and rarely arenaceous foraminifera: *Haplophragmoides* sp. cf. *rugosa* Cushman & Waters, *Haplophragmoides* sp., *Halophragmoides* cf. *glabra* Cushman & Waters.

1016' 8"-1018' 8"—Hard ferruginous greensand, with dominant pale green glauconite and subrounded quartz grains in an ironstone matrix.

1018' 8"-1072' 8"—Grey-green, fairly hard, silty pyritic greensand, with chlorite, muscovite and fish remains. No foraminifera were recovered.

1072' 8"-1104'—Grey-green soft unconsolidated silty greensand, with light green irregular glauconitc grains, fine to medium, angular to subrounded, clear quartz grains with both polished and etched surfaces. Fish remains are present: no foraminifera were detected.

1104'-1470'—At 1104' there is a change in lithology and the greensands are replaced by a light grey carbonaceous mudstone with a hand band at 1365'-1365' 6".

1470'-1471'—Hard brown ferruginous band.

1471'-1486'—Dark grey soft mudstone.

The mudstone is carbonaceous and glauconitic with fine angular quartz grains, both dark and light green glauconite grains, pyrite, and considerable staining with green mineral. An assemblage of small arenaceous foraminifera with Upper Cretaceous affinities is present.

Haplophragmoides spp.
Haplophragmoides cf. *glabra* Cushman & Waters
Spiroplectammina cf. *semicomplanata* (Carsey)
Spiroplectammina sp.
Gaudryina sp.
Verneuilina sp.
Marssonella trochus (d'Orbigny)
Marssonella cf. *ellisorae* Cushman
Trochammina sp.

1486'-1486' 6"—Hard band.

1486' 6"-1523'—Dark grey mudstone, carbonaceous and glauconitic as 1471'-1486', with a similar microfauna.

Haplophragmoides spp,
Haplophragmoides cf. *glabra* Cushman & Waters
Ammobaculites sp.
Spiroplectammina cf. *semicomplanata* (Carsey)
Spiroplectammina sp.
Dorothia spp.
Dorothia cf. *glabrata* Cushman
Trochammina spp.
Cibicides sp.

1523'-1775'—At 1523' the boring entered grey, fine-grained, carbonaceous argillaceous sandstone.

Washings consist of fine angular quartz grains, much silty matter, iron oxide, small grains of pale green glauconite, muscovite, pyrite. The sample effervesces strongly on boiling in washing soda.

No foraminifera were detected.

1775'-1839'—Greenish grey, fine-grained sandstone.

As the previous sample, the sandstone is silty and glauconitic.

1839'-1979'—Grey sandy carbonaceous mudstone, with fine grains of pyrite and pale green glauconite. No foraminifera were observed, but radiolaria (?) *Dictyomitra* and (?) *Cenosphaera* are present.

1979'-1991'—Dark grey-brown, micaceous, carbonaceous sandstone and grit. Washings consist of angular quartz grains, botryoidal hematite, chlorite, kyanite, felspar, actinolite, pyrite, and abundant arenaceous foraminifera mostly undescribed but similar to those occurring in the Lower Cretaceous of the Great Artesian Basin in South Australia.

Involutina sp.
Haplophragmoides dickinsoni Crespin
Haplophragmoides sp.
Textularia anacoorensis Crespin
Siphotextularia sp.
Spiroplectammina spp.
Dorothia sp.
Trochammina cf. *raggatti* Crespin
Trochammina minuta Crespin
Trochammina sp.

1991'-1991' 6"—Hard band.

1991' 6"-2014'—Brown silty fine sandstone.

Washings consist of fine angular quartz grains, silty matter, limonite, chlorite, muscovite.

Involutina spp.
Haplophragmoides dickinsoni Crespin

Haplophragmoides spp.
Haplophragmoides chapmani Crespin
Textularia anacoorensis Crespin
Spiroplectammina sp.
Dorothia sp.
Marssonelia cf. *ozawai* Cushman
Gaudryina cf. *parallela* (Reuss)

2014'-2015'—Hard band.

2015'-2041'—Brown incoherent sandstone. Washings of angular quartz grains, limonite-stained felspar, chlorite, muscovite.
Haplophragmoides dickinsoni Crespin
Haplophragmoides spp.
Textularia anacoorensis Crespin
Marssonella cf. *ozawai* Cushman
Trochammina cf. *raggatti* Crespin
Trochammina sp.

2041'-2049'—Sand debris from bottom of bore, apparently deepened as 2041' noted as being bottom of hole.

2049'-2101'—Grey fine laminated micaceous shale with coarse subangular quartz grains, plant fragments, and muscovite. As only a small amount of core available, sample was not washed for microscopic examination.

Correlation

From surface to 8 feet the bore was logged as passing through light loam.

Quaternary

Pleistocene: 8-30 feet

Below 8 feet the boring passed through 22 feet of Pleistocene shelly limestone typical of that overlying Wilson Bluff Limestone on the Eyre (Roe) Plain.

Tertiary

(i) Eocene *(Wilson Bluff Limestone)*: 30-903 feet

Unfortunately only one sample was kept as typical of the interval 30-508 feet. This is the Wilson Bluff Limestone of Upper Eocene age. The Limestone is glauconitic near the base which is marked by a basal grit 1 foot 8 inches thick.

(ii) Eocene *("Hampton Conglomerate")*: 904 feet 8 inches - 928 feet 3 inches

The formation name was applied by Fairbridge without definition or correlation. Correlation with Eocene sands of the Adelaide Basin is indicated mainly on lithology and on the fact that carbonaceous beds of Eocene age outcrop at Pidinga on the eastern margin of the Eucla Basin. The formation appears to be 22 feet 5 inches thick in the bore.

Cretaceous

(i) Santonian: 927 feet 3 inches - (?) 1523 feet

At 927 feet 3 inches the boring passed into highly glauconitic silty sands grading into greensands. The sediments are carbonaceous with occasional arenaceous foraminifera and fish remains indicating deposition under paralic conditions. No direct correlation is possible from the foraminifera but it is suggested that the greensands may be equivalent to the Molecap Greensand of the Gingin-Dandaragan area.

Below 1471 feet the greensands are replaced by soft mudstones with a microfauna of small arenaceous foraminifera with Upper Cretaceous affinities.

(ii) (?) Cenomanian-Albian: 1523-1979 feet

The only faunal evidence which could be obtained for purposes of correlation within this interval is the presence of *Dictyomitra* sp. and *Cenosphaera* sp. which have been recorded from the Windalia Radiolarite of the North West Division.

(iii) Aptian: 1979-2014 feet.

At 1979 feet the boring passed into carbonaceous sandstones with abundant arenaceous foraminifera typical of Lower Cretaceous (Aptian) sediments of the Roma Series in the Great Artesian Basin in South Australia.

The whole of the Cretaceous sequence is paralic, all sediments being carbonaceous and mostly glauconitic.

Palynological study of the core of this bore should be undertaken to confirm the correlations based on arenaceous foraminifera and to establish the age of the sediments which did not appear to contain any foraminifera, particularly in the intervals 1104-1470 feet, 1523-1979 feet, 2049-2101 feet.

R. W. Fairbridge (1953, p. X1/9) gave the name "Madura Shale" without definition and contrary to the Australian Code of Stratigraphic Nomenclature to a formation claimed to underlie "the Eucla Limestone (and Hampton Conglomerate where present)" and to overlie the Loongana Conglomerate (1953, p. S/9). It is uncertain to which portion of the Madura Bore this is intended to apply. The age of the "Madura Shale" is stated on p. X/9 to be Tertiary, on p. X1/9 to be Cretaceous.

W.A. Government Survey Bore No. 2, 30 miles north of Madura

410 feet above sea level

Reference 4625. Drilled P.W.D.

0'-6'—No core.

6'-30'—Cream dense limestone with molluscan moulds and the foraminifera *Marginopora vertebralis* Blainville and abundant miliolidae.
This is Nullarbor Limestone (Lower Miocene).

30'-34'—No sample available.

34'-72'—Cream partially recrystallized limestone with *Cibicides pseudoungerianus* Cushman, *Gypsina howchini* Chapman, *Amphistegina lessoni* d'Orbigny, *Operculina* sp., *Nonion* sp.

72'-75'—Hard white somewhat chalky limestone.

75'-104'—Cream, partially recrystallized limestone with essentially the same microfauna as 34'-72', poorly preserved but including *Operculina* and *Amphistegina*.

104'-130'—White limestone.

130'-175'—White limestone.

175'-185'—Cream hard recrystallized limestone with *Guttulina* sp. *Cibicides pseudoungerianus* Cushman, *Notorotalia* cf. *howchini* (Chapman, Parr & Collins), *Amphistegina* sp. and a shark's tooth.

185'-200'—Cream limestone.

200'-216'—Hard cream limestone.

216'-230'—Cream recrystallized limestone with a poorly preserved coral.

230'-246'—Cream soft limestone (small sample).

246'-260'—Cream soft limestone (small sample).

260'-284'—Cream recrystallized limestone as 216'-230' with a few bryozoa and foraminifera and an occasional glauconite grain. Diagenesis has proceeded too far for identification of the fauna.

284'-300'—As previous sample.

300'-318'—No core available.

318'-326'—Pink recrystallized limestone with a few poorly preserved foraminifera and bryozoa.

216'-340'—No core available.

340'-360'—Cream recrystallized limestone with echinoid spines, a few foraminifera too poorly preserved for identification. One species appears to be close to or identical with *Cibicides pseudoconvexus* Parr.

360'-410'—No core available.

410'-412'—Cream recrystallized bryozoal limestone with poorly preserved small foraminifera with a Wilson Bluff Limestone aspect.

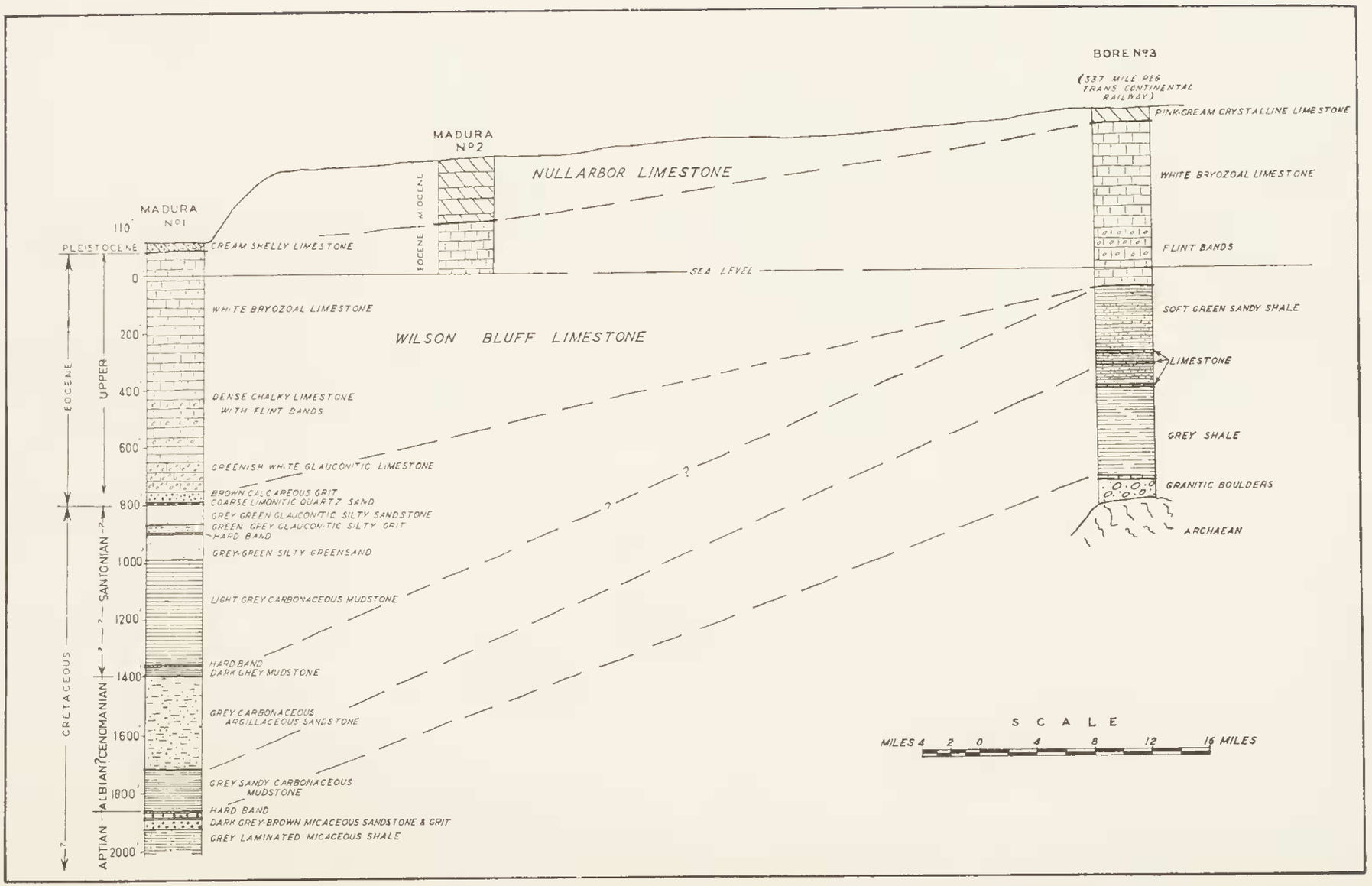

Fig 5.—Section from Madura to 337-mile peg, Trans-Continental Railway, Western Australia.

Correlation

The poor state of preservation of most of the microfossils and the small size of the samples renders it difficult to distinguish clearly the boundary between the Nullabor Limestone which was entered at 6 feet depth, and the Wilson Bluff Limestone in which the boring ceased at 412 feet. The following correlation is therefore tentative only.

0-216 feet *Nullarbor Limestone* (Lower Miocene)—Samples from 34-185 feet carry a microfauna of Lower Miocene age. From 6-34 feet the core is typical of the upper portion of the Nullarbor Limestone while the fauna of the less dense limestone from 34-185 feet with "Batesfordian" affinities occurs near the base of the Nullarbor Limestone elsewhere.

216-318 feet—There is insufficient information available to determine the age of the limestone in this interval. The relatively poor fauna may indicate either transitional sediments of late Oligocene-early Miocene ("Longfordian") age of the weathered upper portion of the Wilson Bluff Limestone.

318-412 feet *Wilson Bluff Limstone (Upper Eocene)*—Although the faunas are poor, the lithology and condition of preservation of the microfauna permits determination of the Wilson Bluff Limestone below 318 feet.

W.A. Government Survey Exploratory Bore No. 3, 337 mile peg Trans-continental Railway, 28 miles west of Loongana

Reference 11229. Drilled P.W.D., 1907

? Surface—Reference 1/1243 1-8

1. Pink hard limestone with numerous corals, bryozoa and molluscan moulds, including:
   Corals: cf. *Placotrochus* sp.
   Pelecypoda: Fulvia sp. cf. *tenuicostata* (Lamarck)
2. Weathered recrystallized limestone with corals (*Placotrochus* etc.), bryozoa, molluscan moulds.

3-8. Selected specimens from the same limestone. These are all samples of weathered Nullarbor Limestone (Lower Miocene), presumably outcropping near the bore.

0'-3'—Surface soil.

3'-50'—Dense pinkish cream crystalline limestone with abundant millolidae and *Marginopora vertebralis* Blainville: Nullarbor Limestone.

50'-65'—No sample: logged as "soft limestone."

65'-67'—White recalcified bryozoal limestone with *Cibicides umbonifer* (?) Parr. Although the faunal evidence is slender, the appearance of the sample suggested that the boring has here entered the Wilson Bluff Limestone (Upper Eocene).

67'-130'—Pink-cream bryozoal limestone.

130'-149'—White bryozoal limestone.

149'-413'—White bryozoal limestone (Wilson Bluff Limestone).

413'-478'—Wilson Bluff Limestone, with flints.

478'-530'—Dense white bryozoal limestone.

530'-630'—No sample logged as "soft limestone with flints."

630'-813'—No sample (logged as soft green sandy shale).

813'-816'—"Hard band" (no sample).

816'-857'—"Sandy shale with hard bands" (no sample).

857'-860'—"Hard bands of shale" (no sample).

860'-890'—"Soft sandy shale."
(?) Sample of greenish grey sandstone with fine angular quartz grains, pale green irregular grains of glauconite.

892'-905'—"Soft sandy shale."

905'-910'—Hard greenish grey limestone.

910'-1270'—Grey carbonaceous mudstone, leaving little residue on washing. Washings consist of fine angular quartz grains, pale green irregular glauconite grains, muscovite, pyrite, with the radiolaria (?) *Lithocyclia* sp., (?) *Dictyomitra* sp. and small impoverished foraminifera *Trochammina* sp. *Siphotextularia* sp.

1270'-1344'—"Fine and coarse sands."
Sample 1290'-1293' is grey limestone, 1293'-1344' grey granite.

1344'-1370'—"Decomposed granite."

1370'-1372'—Gneissic Archaean basement.

Correlation

The loss of labels on some of the deeper core samples has made it difficult to relate these samples to the bore log.

Tertiary limestones

(i) Nullarbor Limestone 3-(?)50 feet

Below surface soil and apparently outcropping in the vicinity of the bore is the Nullarbor Limestone of Lower Miocene age.

(ii) Wilson Bluff Limestone (?) 50-630 feet

At 65 feet, possibly at 50 feet, the boring entered the Upper Eocene Wilson Bluff Limestone of a maximum thickness of 580 feet in the Bore.

(iii) Mesozoic

(a) Albian (in part) 630-1270 feet

The material still available from depths below 630 and 910 feet is insufficient to determine the age of the shale with limestone bands apparently penetrated in this interval. If, as seems possible, the two species recorded by Maitland (1915, p. 13) *Aucella hughendenensis* and *Maccoyella corbiensis*, were recovered here, an Upper Albian age is indicated.

(b) (?) Albian

The name "Loongana Conglomerate" was introduced by Fairbridge (1953, p. X/0) without redescription of the core for the "fine and coarse sand with hard bands and granite boulders" between 1260 and 1314 feet. Only 2 samples are now available, one of which is calcareous and the other granite. There is no evidence to suggest the presence of Aptian sediments.

(iv) Archaean basement.

At 1370 feet the boring entered highly altered basement rock with a calcareous matrix.

W.A. Government Survey, 245 Mile Bore, Transcontinental Railway

Reference 1/319

4 labelled samples

0'-4'—Yellow-brown calcareous clay.

4'-42'—Hard travertine.

42'-96'—Fragments of cream-coloured, hard, dense fossiliferous limestone mixed with surface soil.
The limestone carries abundant miliolidae, together with *Marginopora vertebralis* Blainville.
This is Nullarbor Limestone, of Lower Miocene age.

96'-250'—Cream-coloured, chalky crystalline limestone with some glauconite. Organic remains are poorly preserved but bryozoa, echinoid spines, fragments of brachiopod shells and the foraminifera *Spirillina* sp., cf. *Stomatorbina torrei* (Cushman & Bermudez), *Cibicides umbonifer* Parr, *Cibicides vortex* Dorreen, *Cibicides* sp., *Asterigerina adelaidensis* (Howchin), *Crespinella* sp. B may be recognized. This is Wilson Bluff Limestone, of Upper Eocene age.

Murrawijinnie Cave
Reference 1/1244

Specimen No.

9 Cast of *Polinices* sp. in crystalline limestone (Nullarbor Limestone).
10 Cast of volute indet.
11 Cast of venerid indet.
12 Distorted cast of gastropod indet.
13 Cast of gastropod indet.
14 Cast of gastropod indet.
15 Recrystallized bryozoal limestone with fragment of *Chlamys*.
16 Piece of a stalactite.

Specimens 9-15 have been collected from the Nullarbor Limestone.

Murrawijinnie Bore (80-100 ft depth in shaft)
Reference 1/1245

17 Nullarbor Limestone with *Chlamys eyrei* (Tate) and cast of probably *Antigona* sp.
18 Weathered recrystallized cream bryozoal limestone (Nullarbor Limestone) and *Chlamys eyrei* (Tate).
19 Nullarbor Limestone with *Glycymeris* sp., volute indet, and *Marginopora vertebralis* Blainville.
20 Cast of *Alcithoe (Cottonia)* sp., common at base of Nullarbor Limestone.
21 Limestone with *Vasticardium* sp. and *Marginopora vertebralis* Blainville.
22 No sample.
23 Recalcified limestone, with venerid indet.
24 Recalcified limestone with venerid indet and *Dentalium* sp.
25 Recalcified limestone with gastropod indet.
26 Recalcified limestone with fragment of *Antigona* sp., pelecypod indet, bryozoa, mould of (?) *Placotrochus*.

Specimens 17-26 are from the Nullarbor Limestone.

Delisser's Bore (at 147 ft)
Reference 1/1246

27 Cast of large gastropod (?) *Turbo* sp.
28 Portion of *Nautilus* sp. cf. *geelongensis* Foord.

These belong to the Nullarbor Limestone.

References

Fairbridge, R. W. (1953).—"Australian Stratigraphy." 2nd Ed. (Univ. W. Aust. Text Books Board, Perth.)

Maitland, A. Gibb (1901).—Extension of artesian water-carrying strata from Western Australia. *Annu. Progr. Rep. Geol. Surv. W. Aust.* for 1900: 28-31.

————(1911).—Results of boring for artesian water on the Eucla Plateau. *Annu. Progr. Rep. Geol. Surv. W. Aust.* for 1910: 13-14.

————(1915).—Boring for water on the Trans-continental Railway Line. *Annu. Progr. Rep. Geol. Surv. W. Aust.* for 1914: 13-14.

McGugan, Alan (1957).—Upper Cretaceous foraminifera from Northern Ireland. *J. Paleont.* 31: 329-348.

Tate, R. (1879).—The natural history of the country around the head of the Great Australian Bight. *Trans. Proc. Phil. Soc. Adelaide* for 1878-9: 94-128.